CLAIMS

[C001] 1. An apparatus for entering a flight plan into an aircraft navigation system, said apparatus comprising:

an acoustic sampler adapted for sampling a microphone signal and generating an acoustic signal;

a waypoint identifier adapted for generating an identified waypoint from said acoustic signal and said flight plan; and

a navigation interface adapted for incorporating said identified waypoint into said flight plan and for transmitting and receiving navigation data to and from said aircraft navigation system.

[C002] 2. The apparatus of claim 1 wherein:

said acoustic sampler is further adapted to generate a speech flag signal indicating portions of said acoustic signal corresponding to combinations of pilot speech and cabin noise and portions of said acoustic signal corresponding to cabin noise only; and

said waypoint identifier is further adapted to generate said identified waypoint using said speech flag signal.

[C003] 3. The apparatus of claim 1 wherein said waypoint identifier comprises:

a vocabulary filter adapted for filtering a vocabulary database to yield a feasible vocabulary set;

a geography filter adapted for filtering a geography database using said flight plan to yield a feasible waypoint set; and

a waypoint constructor adapted for constructing said identified waypoint from said feasible vocabulary set and said feasible waypoint set.

[C004] 4. The apparatus of claim 3 wherein said vocabulary database comprises a phonetic alphabet.

[C005] 5. The apparatus of claim 3 wherein said vocabulary filter is further adapted for using said acoustic signal.

[C006] 6. The apparatus of claim 3 wherein said waypoint constructor comprises:

a waypoint filter adapted for filtering said feasible waypoint set using said feasible vocabulary set to yield a candidate waypoint set;

a model generator adapted for generating a waypoint model set from said candidate waypoint set;

a feature extractor adapted for constructing a signal feature set from said acoustic signal; and

a waypoint selector adapted for selecting said identified waypoint by matching said signal feature set to an element of said waypoint model set.

[C007] 7. The apparatus of claim 6 wherein:

said waypoint model set comprises a set of hidden Markov word models;

each of said hidden Markov word models comprises a set of semi-hidden Markov triphone models; and

said waypoint selector uses a Viterbi search method.

[C008] 8. The apparatus of claim 6 wherein said feature extractor uses a zero crossings with peak amplitudes method.

[C009] 9. The apparatus of claim 3 wherein said vocabulary filter comprises:

a zero crossing detector adapted for detecting zero crossings of said acoustic signal to yield a zero crossing set; and

a comparator adapted for comparing said zero crossing set to zero crossing data from said vocabulary database to yield said feasible vocabulary set.

[C010] 10. The apparatus of claim 1 wherein said acoustic sampler comprises:

an analog-to-digital converter adapted for converting said microphone signal to a raw acoustic signal;

a speech detector adapted for generating a speech flag signal from said raw acoustic signal, said speech flag signal indicating portions of said acoustic signal corresponding to combinations of pilot speech and cabin noise and portions of said acoustic signal corresponding to cabin noise only;

a noise model adapted for generating a noise estimate from said raw acoustic signal and said speech flag signal; and

a subtracter adapted for subtracting said noise estimate from said raw acoustic signal to yield said acoustic signal.

[C011] 11. The apparatus of claim 10 wherein said speech detector is further adapted for generating said speech flag signal using a linked hidden Markov model.

[C012] 12. The apparatus of claim 10 wherein said noise model comprises:

a noise extractor adapted for extracting a cabin noise signal from said raw acoustic signal using said speech flag signal;

a magnitude calculator adapted for calculating an estimated magnitude set from said cabin noise signal;

a phase calculator adapted for calculating an estimated phase set from said cabin noise signal; and

a waveform constructor adapted for constructing said noise estimate from a set of noise signatures using said estimated magnitude set and said estimated phase set.

[C013] 13. A method for entering a flight plan into an aircraft navigation system, said method comprising the acts of:

sampling a microphone signal;

generating an acoustic signal from said microphone signal;

generating an identified waypoint from said acoustic signal and said flight plan;

incorporating said identified waypoint into said flight plan; and

transmitting and receiving navigation data to and from said aircraft navigation system.

[C014] 14. The method of claim 13 wherein:

said act of generating said acoustic signal further comprises generating a speech flag signal indicating portions of said acoustic signal corresponding to combinations of pilot speech and cabin noise and portions of said acoustic signal corresponding to cabin noise only; and

said act of generating said identified waypoint further comprises using said speech flag signal.

[C015] 15. The method of claim 13 wherein said act of generating said identified waypoint comprises:

filtering a vocabulary database to yield a feasible vocabulary set;

filtering a geography database using said flight plan to yield a feasible waypoint set; and

constructing said identified waypoint from said feasible vocabulary set and said feasible waypoint set.

[C016] 16. The method of claim 15 wherein said vocabulary database comprises a phonetic alphabet.

[C017] 17. The method of claim 15 wherein said act of filtering said vocabulary database comprises using said acoustic signal.

[C018] 18. The method of claim 15 wherein said act of constructing said identified waypoint comprises:

filtering said feasible waypoint set using said feasible vocabulary set to yield a candidate waypoint set;

generating a waypoint model set from said candidate waypoint set;

constructing a signal feature set from said acoustic signal; and

selecting said identified waypoint by matching said signal feature set to an element of said waypoint model set.

[C019] 19. The method of claim 18 wherein:

said waypoint model set comprises a set of hidden Markov word models;

each of said hidden Markov word models comprises a set of semi-hidden Markov triphone models; and

said act of selecting said identified waypoint comprises using a Viterbi search method.

[C020] 20. The method of claim 18 wherein said act of constructing said signal feature set comprises using a zero crossings with peak amplitudes method.

[C021] 21. The method of claim 15 wherein said act of filtering said vocabulary database comprises:

detecting zero crossings of said acoustic signal to yield a zero crossing set; and

comparing said zero crossing set to zero crossing data from said vocabulary database to yield said feasible vocabulary set.

[C022] 22. The method of claim 13 wherein said act of generating said acoustic signal comprises:

converting said microphone signal to a raw acoustic signal;

generating a speech flag signal from said raw acoustic signal, said speech flag signal indicating portions of said acoustic signal corresponding to combinations of pilot speech and cabin noise and portions of said acoustic signal corresponding to cabin noise only;

generating a noise estimate from said raw acoustic signal and said speech flag signal; and

subtracting said noise estimate from said raw acoustic signal to yield said acoustic signal.

[C023] 23. The method of claim 22 wherein said act of generating said speech flag signal further comprises using a linked hidden Markov model.

[C024] 24. The method of claim 22 wherein said act of generating said noise estimate comprises:

extracting a cabin noise signal from said raw acoustic signal using said speech flag signal;

calculating an estimated magnitude set from said cabin noise signal;

calculating an estimated phase set from said cabin noise signal; and

constructing said noise estimate from a set of noise signatures using said estimated magnitude set and said estimated phase set.